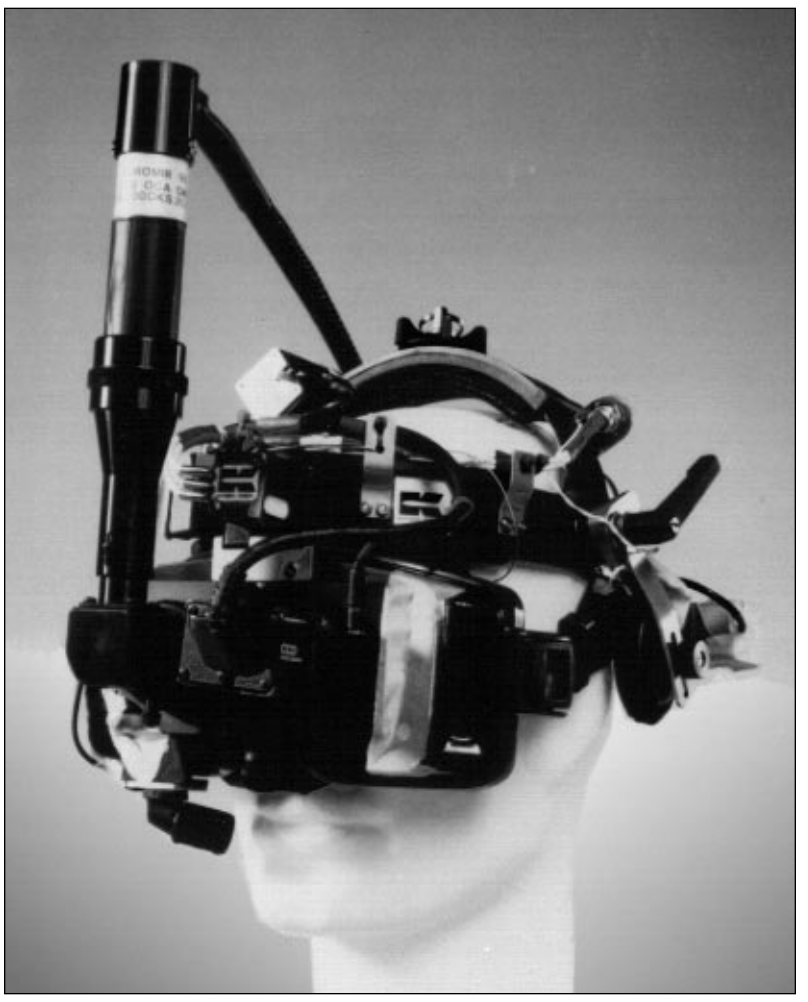
Common Ground

Historic agreement paves way for shared science instruments



JSC's Human Research Facility will coordinate the assembly of a generic set of hardware—developed by individual partner countries— that researchers can use to conduct human life sciences investigations aboard the International Space Station.

Left: The German-built 3-D Eye Tracking System may be used in human factors research as a method of tracking visual search patterns of displays, providing input to a multimedia computer for controlling displays or driving external servo-systems, and for visual/vestibular experiments.

Bottom right: The French-built Kinelite Head and Body Tracking System will be used to analyze the crew motion and monitor all exercise equipment, force/torque measurement equipment, movement in module, and workstation position and movement.

Bottom left: Germany also is building the Lower Body Negative Pressure device which provides an orthostatic tolerance measurement device for cardiovascular research.

By Barbara Tomaro

When laboratory space is at a premium—as it will be on the International Space Station—it isn't logical or cost effective for everyone to bring the same equipment. That's why a new agreement by space station partners on a generic set of life sciences hardware is such an important first.

With the broader context of human efforts in space becoming more focused on international cooperation, it is only one of many important firsts being achieved through the combined efforts of U.S. and international partners.

"You don't need five treadmills up there, just one," said Tim White, assistant to the director of space and life sciences for space station. "If we're going to bring a treadmill, we ought to let other people use it. If we need an electrocardiogram or some other device and someone else wants to build it and has the expertise, then Headquarters said let them bring theirs and we'll use it."

Because all life science research programs are similar, many of the investigators will want to look at the same things. The research and science community recognizes the opportunities and the necessity for international cooperation, White said. None of the participants have infinite budgets, and everyone agrees about the need to have as much different life science equipment as possible in orbit and available to everyone.

NASA Headquarters directed JSC's Space and Life Sciences Directorate to initiate a cooperative effort in human life sciences that will make generic research hardware accessible to domestic and international participants while optimizing the amount of science that can be accomplished within the available resources of the station.

To facilitate this, JSC is working with NASA's international partners to develop the Human Research Facility. HRF provides a generic set of life sciences hardware that researchers can use to conduct human life sciences investigations on board the International Space Station.

The first goal of the HRF is to support the needs of the science community by providing the hardware and the capabilities to collect and distribute data from human life sciences research in space, White said. It is also intended to support NASA's goal of providing meaningful scientific data during the early utilization phase of the ISS. HRF will contribute to the solution of ISS operational issues associated with long duration space flight.

In August 1995, a life sciences hardware workshop was held in Houston with participants from JSC and the international contributors. Requirements and available hardware were compared from each organization. Each agency was asked to propose what they would like to deliver to HRF for early utilization. After setting the basic criteria, the life sciences group at JSC began working out the details with the international contributors.

Over the next months, the JSC group held meetings with the European Space Agency, the French Space Agency, the German Space Agency, the Canadian Space Agency, and the Japanese Space Agency to negotiate a plan that detailed who would be responsible for providing each piece of hardware for the first two racks of the HRF, and to establish a basic schedule for delivery.

At the November 1995 meeting of the International Space Life Sciences Strategic Planning Working Group in Vancouver, Canada, representatives from all the member agencies agreed to begin the process of determining the international life sciences research hardware contributions for HRF. Due to cost and time constraints and the shared interest in life science, they decided that international participation in the creation and delivery of the hardware was the best way to ensure project success. Each agency could bring to the arena its piece of the life science puzzle and contribute its expertise, and in return save money and achieve the benefit of sharing space technology.

Several pieces of hardware were agreed to in principle. ESA was given the responsibility for the Muscle Atrophy Research and Exercise System. This strength measurement device allows scientists to evaluate, in a microgravity environment, the strength of muscle groups associated with the major joints of the human body. ESA also will provide the Hand Grip Dynameter, a hand-held device capable of measuring instantaneous hand strength as a function of time for periods of up to 60 seconds; the Percutaneous Electrical Muscle Stimulator, providing local muscle stimulation in conjunction with measurements of other devices; and the Bone Densitometer, which measures bone density.

France will provide the Head and Body Tracking System designed to monitor, record, and analyze the motion of crew members and to record the performance of experiments during space flight.

Germany's responsibilities include the Lower Body Negative Pressure device which will vacuum seal at the subject's waist and provide an automatic controller to regulate negative pressure applied to the subject's lower torso. In the past, LBNP has allowed scientists to investigate deconditioning of the human cardiovascular system due to long periods of weightlessness.

Germany also will provide the 3-D Eye Tracking System which is a lightweight, head-mounted video camera system capable of measuring and recording eye movements and simultaneous head motion during various vestibular experiments.

The JSC group had to overcome a few minor hurdles to accomplish its mission. Language, cultural, and even time-zone differences were small obstacles to the success of their project. Ultimately, it was a well-balanced combination of the old and new style of communications that proved most successful as face-to-face meetings, fax and e-mail solved many problems. Yvonne Tomaro, Lockheed-Martin Engineering Services International Coordinator for HRF, became the center of communications for the project.

"I'd come in early in the morning with a list of phone calls to make and information to pass on before the international partners went home for the day," she said. "When the Japanese Space Agency joined the mix, even getting in early didn't help. The time difference was just too much. That's when I really had to rely on e-mail and faxes."

On April 12, after a few swift months of negotiations, a significant international first for station life sciences was accomplished in Frascati, Italy, when representatives from all the member agencies agreed to an international approach to science recruitment, review and selection. The first international coordinated research announcement will be released in December of this year. Internationally coordinated research announcements will be released annually.

A top-level protocol was drafted and signed by the directors of life sciences from NASA, and the French and German space agencies. It was agreed that other international life science organizations will contribute human life science equipment to be included as an integral part of the NASA HRF racks 1 and 2 to be flown as early life science utilization on the ISS.

"The station started [international cooperative agreements] at the program level, it was implemented with training and operations, now we're going to do it at the science level," White said.

With this first step toward international cooperation in the area of life sciences, the scientific community has begun a steady march toward space station research. Following the initial agreements, Equipment Contribution Plans were prepared for each agency. These agreements define the roles and responsibilities of each agency and how the equipment will be configured, used, and maintained. They also identify the documentation required, along with other support required by each agency. An approach for the contribution of hardware for HRF racks 1 and 2 was agreed to and accepted by the group. Members of the life sciences community are proceeding to finalize the processes required to implement these agreements.

These agreements, based on mutual respect and mutual necessity, are a clear sign of the future for scientific space research, White said. This protocol, together with hardware sharing and contribution protocols and plans, represent how life sciences research will be carried out on the ISS and beyond. For the first time, multination agencies have agreed to share their individual technology and resources for the benefit of the entire scientific community. ❑